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LOCK, ESPECIALLY FOR MOTOR VEHICLE DOORS, HATCHES, ETC.

The invention pertains to a lock of the type indicated in the introductory clause of Claim 1. The combination motorized closing and opening aid provided makes it easier to close and open the door. A motor, which is controlled by a control unit, puts a gear into motion in one direction or the other. This gear has two takeoff elements, one of which functions as a closing aid, the other as an opening aid. These two elements are therefore referred to in the following as the "closing element" and the "opening element", respectively. The two takeoff elements are permanently connected to the gear and are therefore always put into motion simultaneously.

In the known lock of this type (DE 101 33 092 A1), the two takeoff elements always proceed in opposite directions when actuated. For this reason, two separate takeoff wheels are required. These occupy a large amount of space. The two takeoff wheels must be of adequate size, and the takeoff elements must be mounted on them with a rotational offset from

each other so that their two paths of movement do not intersect. After both the closing process and the opening process have been completed, the motor returns the two takeoff elements from their extreme positions to a middle position. This requires a complicated control system, which occupies a considerable amount of space.

The invention is based on the task of developing a reliable lock of the type cited in the introductory clause of Claim 1 in such a way that it occupies much less space. This is achieved according to the invention by means of the measures stated in Claim 1, to which the following special meaning attaches.

For the mounting of the two takeoff elements, it is enough to provide a single takeoff wheel, on which both of these elements are seated jointly. As a result, the previously required second takeoff wheel is eliminated and space is saved. When the takeoff wheel turns and the paths of movement of the two takeoff elements intersect, there is, however, no interference with the proper functioning of the device for the following reason:

The closing element, which brings about the closing process, lies in a first plane of rotation in the lock, which is to be called the "closing plane", whereas the opening element

responsible for the opening process lies in a second plane of rotation, axially offset from the first plane. This second plane is therefore to be called the "opening plane". The rotary latch has a driver, mounted in the closing plane, for the closing element. When the latch is in the open position, the driver is located outside the rotational path of the closing element, but when the latch is in the prelatching position or in the main latching position, the driver is in the rotational path of the closing element. The pawl has a release finger, positioned in the opening plane, for the opening element. The opening element is mounted with spring-loading in the takeoff wheel and, because of its spring-loading, shifts position automatically with respect to the release finger. When the release finger is pressing on the opening element, the element is kept in its inactive, retracted position, but when the release finger releases the opening element, the element travels into its active, extended position. Thus, even though the two elements are mounted on the same takeoff wheel, there can be no interference with the proper functioning of the lock. The lock always operates reliably.

It is advantageous with respect to the control of the common takeoff wheel for the reversal points of its movement to

be located in the two end positions. When the door is open, therefore, the takeoff wheel is located in the one end position, which, for this reason is called the "open end position". If the takeoff wheel is in the open end position and is then turned in a certain direction, it ultimately reaches its other end position, in which the door is closed. This second end position is therefore called the "closed end position". To reach these two end positions, it is sufficient to let the motorized drive operate until all the parts have moved into solid contact with each other, whereupon the control unit stops the motor in the end position, i.e., stops the rotation or counterrotation of the takeoff wheel.

Additional measures and advantages of the invention can be derived from the subclaims, from the following description, and from the drawings. Although the drawings show only a single exemplary embodiment, this embodiment is shown in various phases of operation and in various operating situations:

-- Figure 1a shows a front view of the lock with the rotary latch in its open position;

-- Figure 1b shows a rear view of the same lock in the same phase of operation;

-- Figure 2 shows a perspective exploded view of the most

important components of the lock;

-- Figure 3 also shows a perspective view of a component of the lock shown in Figure 2, namely, a cam disk, looking in the direction of the arrow III of Figure 2;

-- Figures 4a + 4b show, in analogy to Figures 1a and 1b, front and rear views of the lock after a rear hatch of a vehicle equipped with this lock has been closed to the extent that the rotary latch has arrived in its prelatching position;

-- Figures 5a + 5b show front and rear views of a subsequent operating phase of the lock, where a motor has turned a takeoff wheel to a certain extent in one direction from its original open end position;

-- Figures 6a + 6b show front and rear views of the lock in an operating phase in which the takeoff wheel has been moved into its other end position, i.e., the closed end position, and stopped there, the rotary latch having dropped into its main latching position;

-- Figures 7a + 7b show front and rear views of the lock after the takeoff wheel has rotated in reverse back to its open end position, although here it is in a so-called "snow load" situation, where, because of the icing-up of the rotary latch or because of a load of snow acting on the rear hatch, the rotary

latch is unable to move back under the effect of its spring-loading to its open position but has been released by a pawl.

Let it be assumed that the inventive lock shown in Figures is mounted in the rear hatch of a vehicle (not shown). A lock of this type could, of course, also be installed in a door. In Figures 1a and 1b, the rear hatch is open. A front view of a housing 19 appears in Figure 1a, but the housing has been omitted from the rear view in Figure 1b. A rotary latch 10 is supported on an axis of rotation 18 in this housing. The force of a spring, indicated by the arrow 32, acts on the rotary latch 10. When the hatch is open, the rotary latch 10 is kept in the open position, illustrated by the auxiliary line 10.1, by the spring-loading 32.

The rotary latch 10 has a receptacle 11 for a closing yoke 30, which is permanently attached to the body 33 of the automobile, indicated in dash-dot line. In the drawings, one of the sidepieces of the yoke has been cut away, for which reason the yoke web 31, emphasized by shading, is visible. When the hatch is open, the yoke web 31 is located a certain distance away from the lock. When the hatch is moved in the closing direction as indicated by the arrow 34 of Figure 1a, the yoke web 31 travels into the receptacle 11 and rotates the latch 10

into the prelatching position shown in Figures 4a and 4b and illustrated by the auxiliary line 10.2. This prelatching position is determined by a pawl 20.

As Figure 1a shows, the pawl 20 is rotatably supported at 29 in the housing 19 and is under the action of a spring (not shown). The spring exerts a spring load, illustrated by the force arrow 22, on the pawl 20. The pawl 20 has not only a locking point 21 but also a release finger 23, located on an extension of the pawl. In the open position 10.1 of Figures 1a and 1b, this release finger is supported on a takeoff element 50, to be described in greater detail further below, of a single takeoff wheel 40. The pawl 20 thus now occupies the "ready-to-lock" position illustrated by the auxiliary line 20.1 in Figures 1a and 1b. The open position 10.1 of the rotary latch 10 is determined by the fact that a driver 14 on the rotary latch 10 is supported against an offset shoulder 24 of the pawl 20. As can be seen best in Figure 2, the pawl locking point 21 is formed by the inner end of the pawl shoulder 24.

When the prelatching position 10.2 of Figures 4a and 4b is present, however, the locking point 21 grips a prelatching element 12 on the rotary latch 20. At this point a claw, forming one of the boundaries of the receptacle 11 of the rotary

latch 10, grips the yoke web 31 of the yoke 30, which has traveled into the receptacle. Even though the yoke 30 is thus engaged in the rotary latch 10, there is still a gap between the rear hatch and the automobile body 33. The job now is to close this gap, which is done in motorized fashion by means of a combination closing and opening aid.

In the present case, the closing and opening aid is integrated into the takeoff wheel 40, and the takeoff wheel 40 consists of two disks 41, 42, to be described in greater detail further on. This is illustrated most clearly in the exploded view of Figure 2. The takeoff wheel 40, however, can also have a compact design, in which the two disks 41, 42 always move together in the same way. In this case, the wheel could therefore be easily designed as a one-piece unit. This exemplary embodiment (not shown in detail) is to be described first, but the description also applies to the exemplary embodiment which is shown, namely, the embodiment with the two disks 41, 42, which can move relative to each other under certain conditions. This conditional mobility will be described in detail further below.

The closing and opening aid comprises a motor (not shown) and a gear (not shown), at the end of which the takeoff wheel 40

is mounted. In the open position 10.1 and in the prelatching position 10.2 of the rotary latch, the takeoff wheel 40 is located in its one end position, which is illustrated by the auxiliary line 40.1. Because this end position 40.1 according to Figures 1a and 1b is present when the door is open, it is to be called the "open end position". Two takeoff elements 50, 60 are integrated into the takeoff wheel 40. The first element 50 acts during the closing process and is therefore called the "opening element". When a sensor detects the prelatching position of Figures 4a and 4b, a control unit (not shown) starts the motor in one direction, as a result of which the takeoff wheel turns in the direction marked by the rotation arrow 44 in Figures 5a and 5b.

The first takeoff element 50, which determines the closing process, is to be called the "closing element", whereas the second takeoff element 60, which determines the opening process, is to be called the "opening element". The closing element 50 is assigned to the previously mentioned disk 41 of the takeoff wheel 40 and consists of a cam, to be called the "closing cam", which projects from the rear surface of the disk. For the same reason, this disk 41 is to be called the "cam disk". This closing cam 50 is located outside the actual plane of rotation

of the two disks 41, 42 and lies in the same plane as the rotary latch 10 and the profiled parts around its periphery, which include not only the previously described prelatching element 12 but also the driver tooth 14 and a main latching element 13, to be described later. In Figure 5b, the rotational path 51 of the closing cam 50 during the rotation 44 of the takeoff wheel 40 is indicated by an arrow 51. Whereas, in the open position 10.1 of Figure 1b, the driver tooth 14 is still located outside the rotational path 15, illustrated in dash-dot line, of the closing cam 50, the driver tooth 14 in Figure 4b projects into the rotational path 51. Therefore, during this rotation 44, as illustrated in Figure 5b, the closing cam 50 strikes the driver tooth 14. As a result, the rotary latch 10 is carried along and pivoted in the direction of the motion arrow 15 of Figure 5b against its spring-loading 32.

The motor stops when the takeoff wheel 40 has reached its other end position, which is indicated in Figures 6a and 6b by the auxiliary line 40.2. This end position 40.2 is reached after the locking point 21 of the pawl has dropped behind the main latching element 10.3 of the rotary latch 10. Then the hatch is closed. For this reason, this end position 10.2 is called the "closed end position". The yoke web 31 of the

closing yoke 30 has now penetrated all the way into the lock and is held by the latch 10. As already mentioned, the main latching element 13, the prelatching element 12, and the driver tooth 14 represent profiled parts on the periphery of the rotary latch 10. In the closed end position 40.2, the motor stops. This can be brought about by an end stop, against which the motor travels. Sensors can also be used, however, to detect this closed end position 40.2 and to stop the motor by sending a signal to the control unit.

The second takeoff element on the takeoff wheel 40, namely, the opening element 60, is located in a plane of rotation in the lock which is axially offset from the closing element 50; by analogy, this plane is to be called the "opening plane". The axial offset between the closing plane and the opening plane is easiest to see in Figure 2 on the basis of the pawl 20. Whereas the locking point 21 of the pawl is in the closing plane of the rotary latch 10, its release finger 23 is axially offset and lies in the opening plane, in which the opening element 60 is also located. The opening element 60 consists in the present case of a slider, which is held in a channel 35, best seen in Figure 2, and guided longitudinally therein. This guide channel 35 extends in the present case essentially along a diameter of

the second disk 42, which is therefore to be called the "slider disk". The slider 60 is under the action of a spring 62, which can be seen in Figure 2, and which tries to push the end 61 of the slider out beyond the periphery 36 of the slider disk 42, as can be seen in Figure 5a. The extended position of the slider end 61 is marked here by the auxiliary line 61.1.

In the open end position 40.1 of the takeoff wheel of Figures 1a and 4b, the end 61 of the slider is aligned with the release finger 23 of the pawl 20. The release finger 23 is thus now exerting pressure on the slider 60, as a result of which the slider 60 is pressed into its retracted position, illustrated by the auxiliary line 61.2. During the previously described motorized rotation 44 of the takeoff wheel 40, the end 61 of the slider leaves the release finger 23, which can then rest against the previously mentioned peripheral contour 36 of the slider disk 42, namely, against the support zone 37 designated 37 in Figure 2. The spring 62, which can be seen in Figure 2, generates an elastic force, illustrated by the force arrow 63 in Figure 5a, which pushes the slider 60 back again into its extended position 61.1. End stops (not shown) are provided to ensure that the slider end 61 projects by the desired amount when in its extended position 61.1.

In Figure 5a, as already mentioned, the rotary latch 10 is still in its prelatching position 10.2. The closing yoke 30 has still not traveled inward far enough, as a result of which there is still a gap between the automobile body 33 and the rear hatch. If then the emergency should occur that the rotation 44 of the takeoff wheel 40 must be stopped, because, for example, an object threatens to become jammed in the gap, the lock can be opened quickly again by having the motor turn in the opposite direction. During this reverse rotation of the motor, the takeoff wheel 40 and thus the slider disk 42 are turned in the opposite direction, as shown by the movement arrow 45 in dash-dot line in Figure 5a. The rotational path of the extended end 61 of the slider thus produced is indicated in Figure 5a by a dash-dot rotational arrow 38. During this rotation in the opposite direction, the end 61 of the slider strikes the side of the release finger 23 and thus lifts the locking point 21 of the pawl 20 out of the prelatching element 12 of the rotary latch 10. Under the effect of its spring-loading force 32, the rotary latch 10 can then return automatically to the open position of Figure 1a. In this way, the slider 60 functions as an opening aid for the rear hatch.

Figures 7a and 7b show that the inventive lock functions

without difficulty even in the case that, as previously mentioned, the restoring force 32 is not sufficient to return the rotary latch 10 from its main latching position 10.3 shown here to its open position 10.1 of Figures 1a and 1b, even though the pawl 20 is in its release position, marked by the auxiliary line 20.2, i.e., the position in which the locking point 21 is located outside both the primary latching element 13 and the prelatching element 12 of the rotary latch profile. The reason for this inability, as previously mentioned, can be either that the rotary latch 10 has iced up or that a large amount of snow is weighing down the rear hatch, for which reason this operational situation is called in general the "snow load" situation.

To deal successfully with this snow load situation, it is important not only to design the takeoff wheel 40 in the form of the two previously mentioned disks 41, 42 but also to provide the two disks 41, 42 with the ability to rotate with respect to each other within certain limits. The rotational drive for the takeoff wheel 40 acts on the slider disk 42. For this purpose, as shown in Figures 1a and 7a, a toothed segment 39 is provided on the circumference of the slider disk 42. The rotation of the slider disk 42 is transmitted to the cam disk 41 by a separate

coupling, the design of which can be best described on the basis of Figures 1b and 2.

The coupling is designed as a separate rotational guide, consisting of a pin 17 and a slot 47 in the form of a ring segment. The pin 17 is seated, as Figure 2 shows, on the inside surface 16 of the slider disk 42, i.e., the side which faces an analogous inside surface 26 of the cam disk 26. As a result, the pin 17 engages in the ring slot 47. Between the two disks 41, 42 there is a torsion spring (not shown), which tries to hold the pin 17 against the first rotational stop 48 as shown in Figure 1b, this stop being formed by one end of the slot 47. When the slider disk 42 rotates 44 according to Figure 5a, the rotation 44 is also transmitted to the cam disk 41 by the pin 47, which is resting against the first rotational stop 48, as can be derived from Figure 5b. This remains in effect until the closed end position 40.2 of the takeoff wheel 40, to be described below, of Figures 6a and 6b is reached. To this extent the two disks 41, 42 move in concert with each other, i.e., they act as if they were a single part. In the exemplary embodiment shown here, the limited freedom of rotation of the two disks 41, 42 is important for the following reason.

In the closed end position 40.2, as Figure 6b illustrates,

the closing cam 50 of the takeoff wheel 40 has moved away from the tip 25 of the driver tooth 14. Not only the front edge 52 but also the rear edge 53 of the closing cam 50 are now on the other side of the tip 25 of the driver tooth 14. The closing cam 50 is thus in an "overstroke" position, designated by the distance 54 in Figure 6b. In this exemplary embodiment of the lock, as the associated Figure 6a shows, this overstroke is accompanied by a corresponding further movement of the slider 60. Because of its spring-loading 63, the end 61 of the slider is already in its extended position 61.1 in Figure 5a at the time this overstroke occurs. Because of this overstroke 54, that which occurs in the snow load situation according to Figures 7a and 7b now occurs in the normal case as well during the reverse rotation 45 of the takeoff wheel 40 even when the takeoff wheel 40 is in the open end position 40.1. This is what happens in detail:

The process starts from the closed end position 40.2 shown in Figure 6a. When the motor starts, the reverse rotation 45 causes only the slider disk 42 to move at first in the reverse direction 45 via the toothed segment 39. For this reason, as Figure 6b shows, the pin 17 also executes this reverse rotation 45. Because of the previously mentioned spring-loading between

the two disks 41, 42, the cam disk 41 can also follow this reverse rotation 45 initially over the distance of the overstroke 54, but the cam disk 41 is stopped from rotating any farther as soon as the rear edge 53 of the closing cam 50 strikes the tooth tip 25. Then, as the reverse rotation 45 continues, the pin 17 in Figure 6b continues to move under no load in the ring slot 47. During this further rotation, the torsion spring located between the two disks 41, 42 is put under tension.

During the course of the reverse rotation 45, however, as already explained on the basis of Figure 5a, the extended end 61 of the slider, as it passes along its path of rotation designated 38 in Figure 5a, strikes the release finger 23 and lifts the pawl 20 out of the latch 10 in the manner previously described. When this understanding is also applied to the previously described situation according to Figure 6b, we see that the tip 25 of the driver tooth 14 also moves away from the rear edge 53 of the cam during the spring-induced reverse rotation 32 of the latch 10. Then the closing cam 50 is free, and the torsion spring acting between the disks 41, 42 rotates the cam disk 41 automatically back into its resting position shown in Figure 1b, in which the pin 17 rests elastically

against the rotational stop 48 again. The closing cam 50 on the one side and the slider 60 on the other are now essentially aligned with each other again in the same angular range of the two-disk takeoff wheel 40. In the snow load situation according to Figures 7a and 7b, the following special feature then also plays a role:

The special feature is that, in the snow load situation according to Figure 7a, the end 61 of the slider remains in its extended position 61.1, even though the pawl 20 is exerting a restoring force 22 on it by way of the release finger 23. That is, in this snow load situation, the slider 60 is not able to slide longitudinally and is instead arrested in its extended position 61.1. To accomplish this, the following simple, space-saving operating means are used in the invention.

As can be seen in Figure 2, the end 61 of the slider is provided with an axial projection 64, which extends in a direction parallel to the axis 27, indicated in dash-dot line. The axial end surface of this axial projection 64 is emphasized by shading in Figures 2, 5b, 6b, and 7b. When the slider 60 is installed in the guide channel 35 of the slider disk 42, the axial projection 64 projects beyond the inside surface 16 of the slider toward the adjacent cam disk 41. As Figure 3 makes

clear, the inside surface 26 of the cam disk 41 is provided with a channel extension 28, into which the axial projection 64 of the slider end 61 can be pushed. This is always the case when the guide channel 35 of the slider disk 42 is aligned with the channel extension 28 of the cam disk 41. Under normal operating conditions, this is always the case during the closing operation. During the opening process, however, this situation exists only during the final phase because of the overstroke 54.

During the reverse rotation 45 explained on the basis of Figure 6b, the cam disk 41 is stopped as soon as it travels back over the distance of the overstroke 54 and its rear edge 53 meets the tooth tip 25, as previously explained. As rotation 45 continues, the support surface 65 of the axial projection 64, i.e., the surface facing toward the axis 27 in Figure 2, moves onto a guide segment 49, which is formed by the circular periphery of the cam disk 41. As Figure 3 shows most clearly, the guide segment 49 proceeds immediately from the opening of the channel extension 28 in the cam disk 41. When the support surface 65 of the axial projection 64 makes contact with this guide segment 55, however, the extended end 61 of the slider can no longer be pushed in. This is especially easy to see in Figure 7b, which illustrates the snow load situation. Whereas

the channel extension 28 remains almost exactly in the closed end position 40.2 according to Figure 6b, the axial projection 64, emphasized by shading, is carried along positively in the slider disk 42 and thus ultimately arrives in the other, i.e., open, end position 40.1. It is inward-pointing support surface 65 thus travels along the guide segment 55 on the circumference of the cam disk 41 and thus prevents the end 61 of the slider from being pushed in.

In the end position of the snow-load situation according to Figure 7a, the motor, acting by way of its gear on the toothed segment 39 of the slider disk 42, has returned the slider disk in the direction of the dash-dot arrow 45 in the reverse direction to the previously described open end position 40.1. At the same time, as Figure 7b shows, the pin 17 seated on the slider disk 42 moves along the ring slot 47 in the blocked cam disk 41 toward the opposite end 49 of the slot. It is not necessary for another rotational stop to occur between 17 and 49. If it is possible to lighten the snow-load pressure acting between the yoke web 31 and the rotary latch 10 by removing the snow from the hatch to such an extent that the restoring spring 32 can cause the rotary latch 10 to rotate back out of its main latching position 10.3 of Figure 7b and into the open position

10.1 of Figure 1a, then the tensioned torsion spring between the disks 41, 42 will also pull the cam disk 41 of Figure 7b in the reverse direction shown by the dash-dot arrow 45. As this happens, the slider disk 42 and its pin 17 remain in the resting position shown in Figures 7a and 7b. The cam disk 41 continues to turn until the stop end 48 of its ring slot 47 meets the resting pin 17. Then the channel extension 48, at first still offset in Figure 7b, is back in alignment with the axial projection 64, emphasized by shading. The support surface 65 of the axial projection 64 is no longer supported and is thus free to move. The restoring force 22 of the pawl 20 can then push the slider end 61 via the release finger 23 back into the takeoff wheel 40. As this happens, the slider moves inward in its guide channel 35, indicated in dotted line in Figure 7a, and the axial projection 64 enters the aligned channel extension 68. Now the operating conditions illustrated in Figures 1a and 1b are restored. The lock is ready for operation again.

List of Reference Numbers

- 10 rotary latch
- 10.1 open position of 10 (Figure 1a)
- 10.2 prelatching position of 10 (Figure 4a)
- 10.3 main latching position of 10 (Figure 6a)
- 11 receptacle in 10 for 30
- 12 prelatching element on 10
- 13 main latching element on 10
- 14 driver, driver tooth
- 15 arrow of the pivoting motion of 10 (Figure 5)
- 16 inside surface of 42 (Figure 2)
- 17 pin on 41 of the rotational guide
- 18 axis of rotation of 10
- 19 lock housing
- 20 pawl
- 20.1 ready-to-lock position of 20
- 20.2 release position, lifted-out position of 20
- 21 locking point of 20
- 22 arrow of the spring-loading of 20
- 23 release finger
- 24 shoulder on 20
- 25 tip of tooth 14

26 inside surface of 41
27 axis of the lock (Figure 2)
28 channel extension in 41 (Figure 3)
29 bearing axis of 20
30 lock yoke
31 yoke web of 30
32 arrow of the spring-loading of 10
33 automobile body
34 arrow of the closing movement of a hatch
35 channel, guide channel in 42 for 60 (Figure 2)
36 peripheral contour of 42
37 support zone for 23 on 42 (Figure 2)
38 arrow of the rotation of 61 (Figure 5a)
39 toothed segment on 42 (Figures 1a, 7a)
40 takeoff wheel
40.1 open end position of 40
40.2 closed end position of 40
41 disk, cam disk
42 disk, slider disk

44 first travel direction of 40, rotation
45 second, reverse travel direction of 40, reverse
 rotation

46 end surface of 41
47 ring segment-like slot in 41 of the rotational guide
48 first rotational stop in 47 for 17 (Figure 1b)
49 second end of 47 for 17 (Figures 7b, 3)
50 takeoff element for the closing process, closing element, closing cam
51 rotational path of 50 (Figure 5b)
52 front edge of 50 (Figure 6b)
53 rear edge of 50 (Figure 6b)
54 overstroke of 50 (Figure 6b)
55 guide segment, periphery of 41 (Figures 2, 7)

60 takeoff element for the opening process, opening element, slider
61 end of slider 60 (Figures 2, 5a)
61.1 extended position of 61 (Figure 5a)
61.2 retracted position of 61 (Figure 1a / 4a)
62 spring
63 arrow of the spring force of 62 acting on 60 (Figure 6a)
64 axial projection on 61 (Figure 2)
65 support surface on 64 (Figure 2)